WATER RESOURCES REVIEW for AUGUST 1973

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

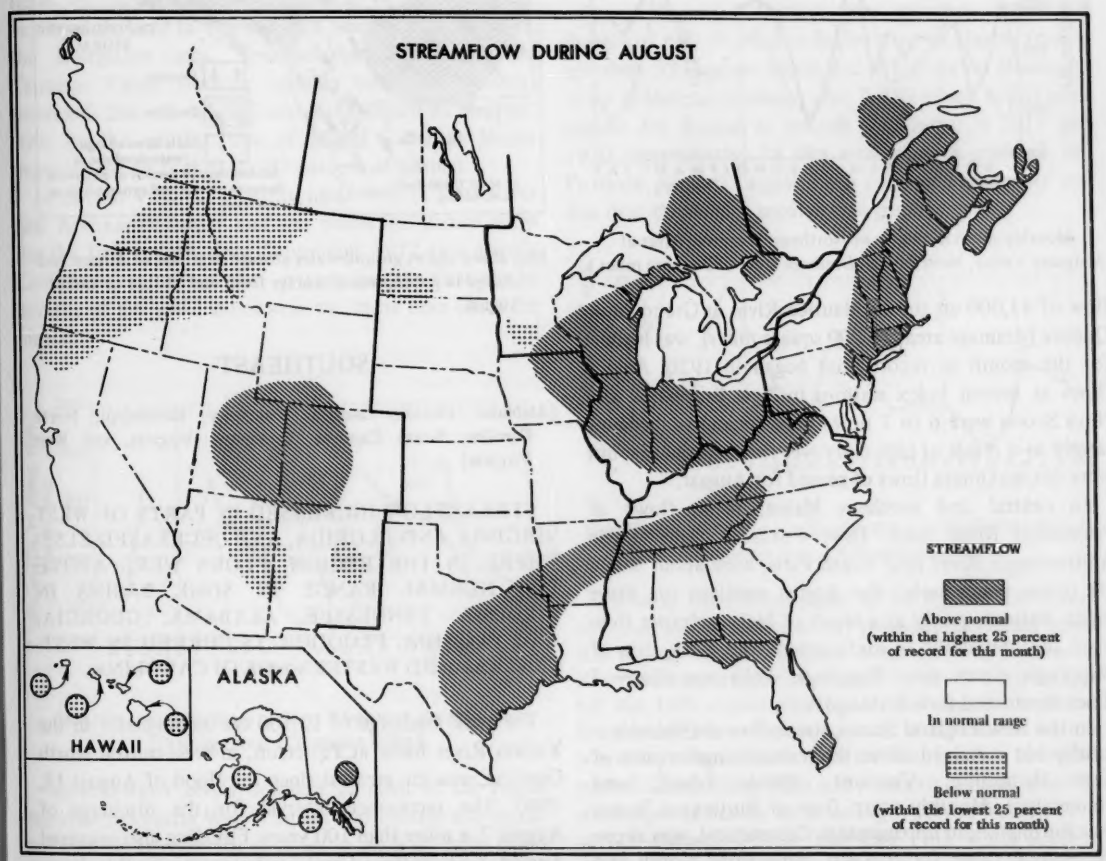
CANADA
DEPARTMENT OF THE ENVIRONMENT
WATER RESOURCES BRANCH

STREAMFLOW AND GROUND-WATER CONDITIONS

Streamflow generally decreased in southern Canada, in Hawaii and south-central Alaska, and in most of the conterminous United States, but increased in parts of the Atlantic Provinces and Quebec, and in a few basins elsewhere in the United States.

Above-normal streamflow conditions occurred in large areas of southeastern Canada and eastern United States, as well as in large parts of Texas, Colorado, and Utah. Below-normal flows persisted in Hawaii and in large parts of the four northwestern States and adjacent northern California. In these areas, minimal precipitation during August intensified drought conditions, including lowest-of-record August flows on some streams. Flows were also below normal in smaller areas in Arizona, New Mexico, North Dakota, and Minnesota.

Flooding occurred in parts of Nebraska, Iowa, Indiana, and North Carolina.



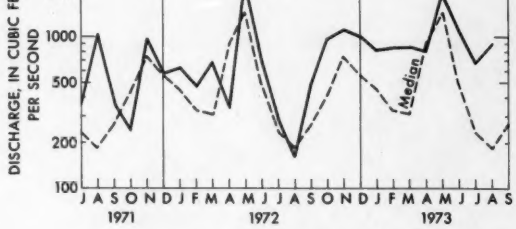
CONTENTS OF THIS ISSUE: Northeast, Southeast, Western Great Lakes region, Midcontinent, West, Alaska, Hawaii; Hydrographs of two large rivers; Usable contents of selected reservoirs near end of August 1973; Basic data reports on stream discharges, quality of surface water, and ground-water levels; Flow of large rivers during August 1973; Water resources and geology of Mount Rushmore National Memorial, South Dakota.

NORTHEAST

[Atlantic Provinces and Quebec; Delaware, Maryland, New York, New Jersey, Pennsylvania, and the New England States]

STREAMFLOW GENERALLY INCREASED AND WAS ABOVE THE NORMAL RANGE IN THE ATLANTIC PROVINCES AND PARTS OF QUEBEC. FLOWS DECREASED BUT WERE ABOVE NORMAL IN MUCH OF MAINE AND THE NEW ENGLAND STATES, AND IN PARTS OF NEW YORK, NEW JERSEY, PENNSYLVANIA, AND MARYLAND.

Record-breaking August flows occurred on two Canadian streams in the region. The monthly mean discharge of 926 cfs on Northeast Margaree River at Margaree Valley, Nova Scotia (drainage area, 142 square miles), was highest for August in 57 years of record and 5 times the monthly median (see graph). Also the mean



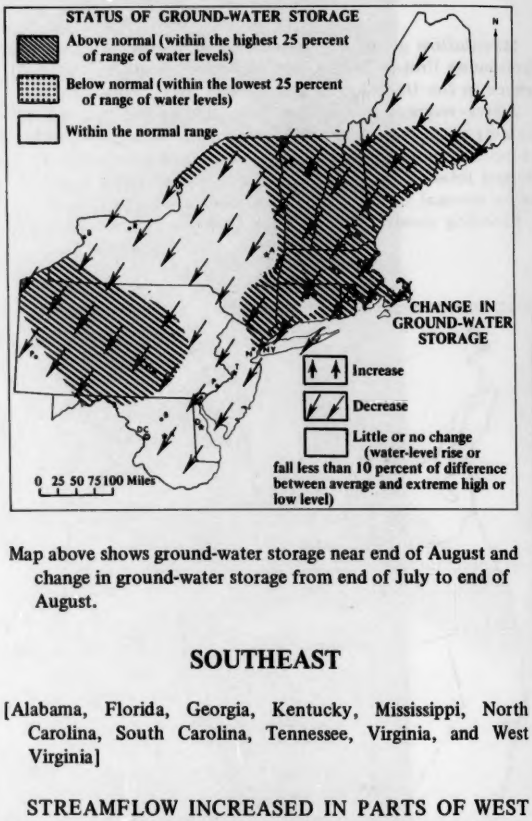
Monthly mean discharge of Northeast Margaree River at Margaree Valley, Nova Scotia (Drainage area, 142 square miles.)

flow of 41,000 cfs on St. Maurice River at Grand Mere, Quebec (drainage area, 16,200 square miles), was highest for the month in record that began in 1920. August flows at several index stations in New Brunswick and Nova Scotia were 6 to 7 times their respective medians, largely as a result of high carryover flows from July, but were not maximum flows of record for August.

In central and southern Maine, mean flows of Piscataquis River near Dover-Foxcroft, and Little Androscoggin River near South Paris, were about 9 and 10 times, respectively, the August medians for those index stations, partly as a result of high carryover flow from July. Similarly, in southeastern New York, flow of Wappinger Creek near Wappinger Falls was nearly 5 times the normal flow for August.

In the New England States, streamflow decreased seasonally but remained above the normal range in parts of New Hampshire, Vermont, Rhode Island, and Connecticut. Monthly mean flow of Burlington Brook near Burlington, in northwestern Connecticut, was above the normal range for the 4th consecutive month and nearly triple the August median. Nearby, in northern New Jersey, flow of South Branch Raritan River near High Bridge was above the normal range for the 10th consecutive month and nearly 3 times the median for August.

Ground-water levels continued seasonal declines in most of the region (see map). However, levels remained in the above-normal range in most of New England and in central Pennsylvania as well as in smaller parts of Maryland, New Jersey, and New York.


STATUS OF GROUND-WATER STORAGE
Above normal (within the highest 25 percent of range of water levels)
Below normal (within the lowest 25 percent of range of water levels)
Within the normal range
N
CHANGE IN GROUND-WATER STORAGE
Increase
Decrease
Little or no change (water-level rise or fall less than 10 percent of difference between average and extreme high or low level)
0 25 50 75 100 Miles

Map above shows ground-water storage near end of August and change in ground-water storage from end of July to end of August.

SOUTHEAST

[Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, Tennessee, Virginia, and West Virginia]

STREAMFLOW INCREASED IN PARTS OF WEST VIRGINIA AND FLORIDA, AND DECREASED ELSEWHERE IN THE REGION. FLOWS WERE ABOVE THE NORMAL RANGE IN SOME BASINS IN VIRGINIA, TENNESSEE, ALABAMA, GEORGIA, AND FLORIDA. FLOODING OCCURRED IN WEST-CENTRAL AND WESTERN NORTH CAROLINA.

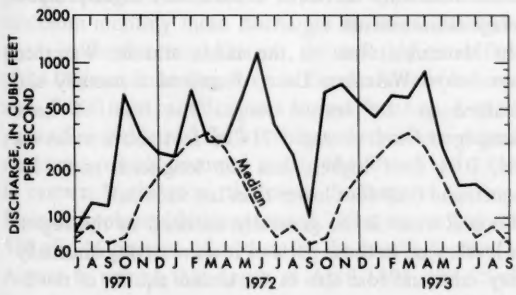
The peak discharge of 12,100 cfs on August 7 in the Yadkin River basin at Patterson, in west-central North Carolina, was the greatest since the flood of August 13, 1940. The recurrence interval for the discharge of August 7 is more than 100 years. Flooding also occurred August 7 on Buffalo Creek, tributary to Yadkin River

downstream from Patterson. Damage to crops, highways, industrial plants, and recreational facilities on the flood plains of those two streams was reportedly more than $1 million. Minor flooding occurred along some small streams in western North Carolina August 13 and 14. In the basin of South Yadkin River in the west-central part of the State, cumulative runoff October 1972 through August 1973 at the index station near Mocksville was second highest for that 11-month period in records that began in 1931.

In the central part of the region, flows at index stations in southwestern Virginia, central Tennessee, and parts of Georgia, remained above the normal range for the fourth consecutive month; and in eastern South Carolina, monthly mean flow of Pee Dee River at Peedee has been above the normal range continuously since November 1972.

In northern Florida, monthly mean flows in Shoal, Apalachicola, and Suwannee River basins were above the normal range for August. Flows in the Everglades, in extreme southern Florida, were also above the normal range. In northern Florida, discharge of Silver Springs increased 214 cfs to 960 cfs; 122 percent of normal. In the Everglades area, flow southward through the Tamiami Canal outlets, 40-mile bend to Monroe, increased 260 cfs to 820 cfs; 228 percent of normal. Also in the south, flow of Miami Canal at Miami increased 82 cfs to 329 cfs; 97 percent of normal.

In central Virginia, monthly mean flow of Slate River near Arvonia decreased and was below the normal range for the first month since September 1972 (see graph). Cumulative runoff at that station for the first eleven months of the 1973 water year was more than twice the median.



Monthly mean discharge of Slate River near Arvonia, Va.
(Drainage area, 226 square miles.)

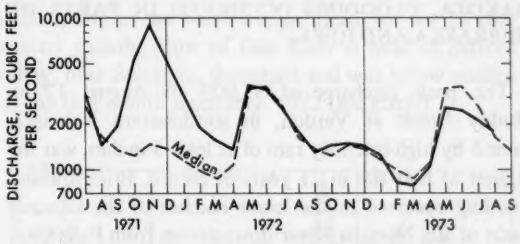
Ground-water levels declined in most of the region but rose in central West Virginia and central and southern Florida (except for declines in parts of Palm Beach and north Dade Counties). Monthend levels were generally above average in North Carolina (except in several heavily pumped Coastal Plain areas), Alabama, Kentucky, and central and southwestern West Virginia; and were below average in northern and southeastern West Virginia.

WESTERN GREAT LAKES REGION

[Ontario; Illinois, Indiana, Michigan, Minnesota, Ohio, and Wisconsin]

STREAMFLOW GENERALLY DECREASED BUT REMAINED ABOVE THE NORMAL RANGE IN PARTS OF ONTARIO, WISCONSIN, ILLINOIS, INDIANA, AND OHIO, AND BELOW THE NORMAL RANGE IN SOUTHWESTERN MINNESOTA. RECORD-BREAKING FLOWS OCCURRED IN SOUTH-CENTRAL ONTARIO. FLOWS INCREASED BUT REMAINED IN THE NORMAL RANGE IN PARTS OF OHIO, MICHIGAN, AND MINNESOTA. MINOR FLOODING OCCURRED AT MIDMONTH IN INDIANA.

In south-central Ontario, the monthly mean discharges of 650 cfs on Aux Sables River at Massey (drainage area, 524 square miles) and 4,150 cfs on Missinaibi River at Mattice (drainage area, 3,450 square miles) were highest for August in records that began in 1915 and 1920, respectively. In the southwestern part of the Province, flow of English River decreased seasonally and was near the August median (see graph).



Monthly mean discharge of English River at Umfreville, Ontario
(Drainage area, 2,470 square miles.)

Flows in the southern part of the region, and in eastern and southern Wisconsin, generally remained above the normal range. Monthly mean flow of Pecatonica River at Freeport, Illinois, was in the above-normal range for the 13th consecutive month and cumulative runoff for the 1973 water year to date, at that index station, was more than double the median for the 11-month period. In southern Ohio and southern Indiana, monthly discharges of Scioto River at Higby, Ohio, Wabash River at Mt. Carmel, Illinois, and East Fork White River at Shoals, Indiana, have been in the above-normal range for

3 consecutive months. In north-central Indiana, minor flooding occurred in the Kokomo area August 15 and 16.

In Michigan, streamflow decreased seasonally and generally was in the normal range. In southwestern Minnesota, flow of Minnesota River continued to decrease and was below the normal range for the 2d consecutive month.

Ground-water levels in shallow water-table wells declined seasonally in most of the region other than in northern Minnesota where levels rose because of recharge from above-normal rainfall. Monthend levels remained above average in Indiana, Michigan, and northern Minnesota; were near average in Ohio; and were below average in southern Minnesota. Levels in wells tapping artesian aquifers underlying the Minneapolis-St. Paul, Minn., area, rose as a result of decreased pumping but remained below average.

MIDCONTINENT

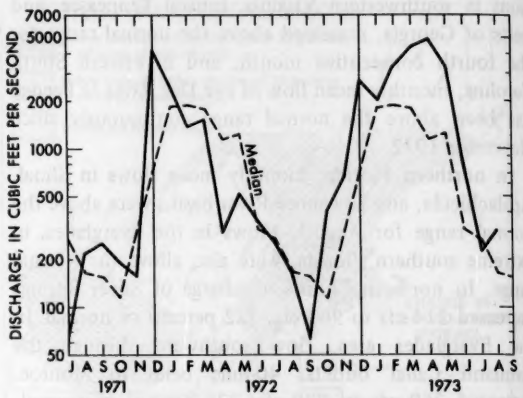
[Manitoba and Saskatchewan; Arkansas, Iowa, Kansas, Louisiana, Missouri, Nebraska, North Dakota, Oklahoma, South Dakota, and Texas]

STREAMFLOW INCREASED IN PARTS OF NORTH DAKOTA, SOUTH DAKOTA, ARKANSAS, AND LOUISIANA, AND DECREASED ELSEWHERE IN THE REGION. FLOWS WERE ABOVE THE NORMAL RANGE IN EASTERN IOWA, SOUTHERN ARKANSAS, AND EAST-CENTRAL TEXAS, AND BELOW THAT RANGE IN SOUTHWESTERN NORTH DAKOTA. FLOODING OCCURRED IN PARTS OF NEBRASKA AND IOWA.

The peak discharge of 35,000 cfs August 12 on Muddy Creek at Verdon, in southeastern Nebraska, caused by high-intensity rain of at least 5 inches, was the highest at that site in 21 years of record. Brief lowland flooding occurred in the lower reaches of the adjacent basin of Big Nemaha River downstream from Falls City. During the evening of August 14, intense rain of 2 to 4 inches caused some local inundation and erosion in the Ord and North Loup areas of central Nebraska. In northwestern Iowa, flooding occurred along Little Sioux River at and near Peterson, as a result of about 9 inches of rain August 22–23. Bankfull stages on some streams in northern Missouri resulted from thunderstorm activity August 8–10 and 14–16.

High carryover flows from July contributed to the above-normal monthly mean flows during August in some basins of central Texas and eastern Iowa. Flow of Guadalupe River near Spring Branch, Texas, was nearly 9 times the August median, and the monthly mean flow of Cedar River at Cedar Rapids, Iowa, remained in the above-normal range for the 14th consecutive month. In southern Arkansas, flow of Saline River near Rye, increased sharply as a result of a thunderstorm early in the month, and the monthly mean was more than 6 times the August median.

In Louisiana, streamflow generally decreased in the north and increased in the south. Monthly mean flow at the index station, Calcasieu River near Oberlin, increased slightly and remained in the normal range (see graph).



Monthly mean discharge of Calcasieu River near Oberlin, La. (Drainage area, 753 square miles.)

Storage in major reservoirs in Oklahoma was at or near average at monthend. In western Nebraska, releases from Enders Reservoir, on Frenchman Creek, were reduced to 150 cfs August 27 because of the shortage of water in storage. This reservoir was only partially filled when the current irrigation season began. Storage in the smaller reservoirs in North Dakota was slightly below average at monthend.

In Manitoba, flow at the index station, Waterhen River below Waterhen Lake, decreased seasonally and remained in the normal range. The level of Lake Winnipeg at Gimli averaged 714.06 feet above mean sea level, 0.01 foot higher than the long-term mean for August, and 0.09 foot lower than last month.

Ground-water levels generally declined in the region but levels rose in those parts of Iowa receiving unusually heavy rains and rose also in the terrace aquifer of north-central Louisiana—still responding to recharge from rains of late spring and early summer. In east-central Arkansas, levels rose slightly in the shallow aquifer in the Grand Prairie rice-growing area and were in the same range of August levels that have occurred since 1954. In central and southern Arkansas, the level in the industrial aquifer (Sparta Sand) in the key well at Pine Bluff

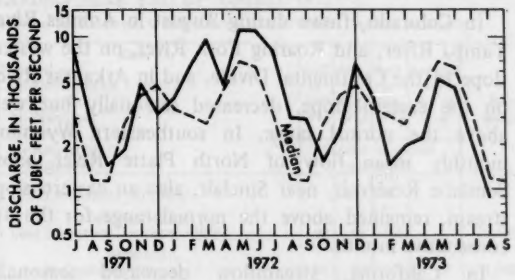
declined 4 feet and nearly equalled the previous alltime low (October 1972, 12 feet below average); whereas the level in the key well at El Dorado, while falling 3 feet, was 6½ feet above average and 27 feet above the lowest August level (1969) of record. Monthend levels were above average in Nebraska (except in heavily pumped areas); and below average in North Dakota. In Texas, levels rose in the Edwards Limestone at Austin and in the Evangeline aquifer at Houston; and fell in the Edwards Limestone at San Antonio and in the bolson deposits at El Paso. Monthend levels remained above average at Austin and San Antonio, and below average at Houston and El Paso.

WEST

[Alberta and British Columbia; Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming]

STREAMFLOW DECREASED IN ALL PROVINCES AND STATES OF THE REGION EXCEPT IN PARTS OF ARIZONA WHERE SOME MINOR SEASONAL INCREASES OCCURRED. FLOWS REMAINED BELOW THE NORMAL RANGE IN A LARGE AREA IN THE NORTHWEST, AS A RESULT OF DROUGHT CONDITIONS, AND BELOW-NORMAL FLOWS OCCURRED ALSO IN SMALLER AREAS IN ARIZONA AND NEW MEXICO. RECORD, OR NEAR-RECORD LOW MONTHLY MEAN DISCHARGES OCCURRED IN PARTS OF MONTANA, IDAHO, WASHINGTON, AND OREGON.

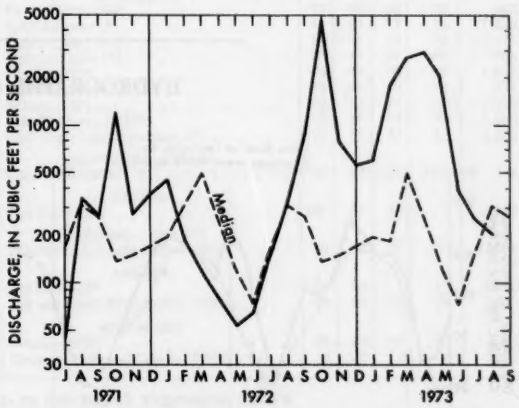
Although the area of below-normal streamflow in the northwest, resulting from drought conditions, remained essentially the same as in July, the continued absence of precipitation and decrease in streamflow, produced new minimum monthly mean discharges at several index stations. In north-central Oregon, the monthly mean flow of 24.0 cfs on John Day River at Service Creek (drainage area, 5,090 square miles) was lowest for August in 43 years of record, and 2.7 cfs less than the previous August minimum, which occurred during the drought of 1931. In eastern Washington, the mean discharge of Spokane River at Spokane (drainage area, 4,290 square miles) was 520 cfs, 46 percent of median for the month, lowest for August in record that began in April 1891, and 95 cfs less than the previous August minimum, which also occurred during the drought of 1931. In the northwestern part of Washington, flow of Skykomish River near Gold Bar decreased sharply to 75 percent of the August median but remained in the normal range (see graph). In northwestern Montana, the monthly mean discharges of 1,760 cfs on Clark Fork at St. Regis (drainage area, 10,709 square miles), and 167 cfs on Marias River



Monthly mean discharge of Skykomish River near Gold Bar, Wash. (Drainage area, 535 square miles.)

near Shelby (drainage area, 3,240 square miles), were lowest for August since 1940 and 1961, respectively. During the drought of 1919, the August monthly mean flow of Marias River at Shelby was 79.0 cfs. The previous minimum August mean flow on Clark Fork at St. Regis, in 62 years of record, was 1,450 cfs in 1931. In north-central Idaho, the August mean flow of Clearwater River at Spalding, adjusted for storage in Dworshak Reservoir, was lowest for August in 50 years of record, and the flow of Salmon River at White Bird remained below the normal range for the 5th consecutive month.

Below-normal flows occurred also in the Pecos River basin of east-central New Mexico, where the August mean flow was only 40 percent of median, and in the Gila, Little Colorado, and San Pedro River basins in eastern and northern Arizona. Flow of Little Colorado River near Cameron, in the northern part of the State, increased, but was less than 1 percent of the August median, and in the below-normal range for the 2d consecutive month. Flow of Gila River at head of Safford Valley, near Solomon, decreased and was below median for the first month since July 1972 (see graph).



Monthly mean discharge of Gila River at head of Safford Valley, near Solomon, Ariz. (Drainage area, 7,806 square miles.)

In Colorado, flows during August in Animas River, Yampa River, and Roaring Fork River, on the western slope of the Continental Divide, and in Arkansas River, on the eastern slope, decreased seasonally but were above the normal range. In southeastern Wyoming, monthly mean flow of North Platte River above Seminoe Reservoir, near Sinclair, also an eastern slope stream, remained above the normal range for the 4th consecutive month.

In California, streamflow decreased seasonally throughout the State and was in the normal range except in the north-coastal area where flow of Smith River near Crescent City remained below the normal range for the 4th consecutive month.

In Utah, streamflow decreased seasonally but was above the normal range in all parts of the State except the southeast. The level of Great Salt Lake declined 0.55 foot during the month (to 4,199.30 feet above mean sea level), and was 1.10 feet higher than a year ago.

Storage in major reservoirs generally was below average in Oregon, Washington, Nevada, and southern Idaho, and above average elsewhere in the region. At monthend, the power shortage in Washington was reported to be critical, and voluntary curtailment of power usage had begun. Contents of the Colorado River Storage Project decreased 139,300 acre-feet during August.

Ground-water levels continued falling in Washington and fell also in most wells in Montana, Nevada, northern Idaho, north-central Utah, and southern parts of Arizona and New Mexico. In southern California, levels declined or stayed about the same. In southern Idaho, levels rose or changed only slightly. Levels rose in southern and extreme northern Utah. Monthend levels were generally below average in Washington, Montana, Utah, and southern Arizona and New Mexico; were near average in Nevada and southern California, except in heavily pumped areas; and were above average in much of southern Idaho other than the heavily pumped Rupert-Minidoka area. In southeastern Arizona, the level in the key well in the Willcox basin was at an alltime low for the 21 years of record.

ALASKA

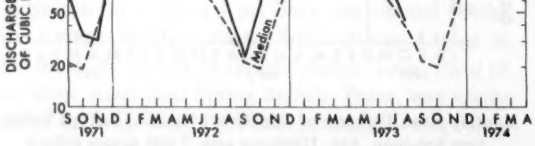
Streamflow increased into the above-normal range at the index station, Gold Creek near Juneau, in the southeast, and also increased, but remained in the normal range on Chena River at Fairbanks, in the interior. Monthly mean flow of Tanana River at Nenana, also in the interior, decreased seasonally and was in the normal range. Flows in the south-central basins of Kenai River and Little Susitna River decreased seasonally and were below the normal range.

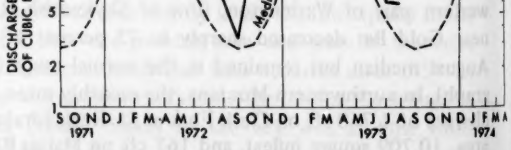
Ground-water levels rose slightly in the Anchorage and Kenai areas.

HAWAII

Streamflow decreased and was below the normal range in all parts of the State. The monthly mean discharge of 0.40 cfs, and the daily mean of 0.29 cfs August 23–31, at the index station, Honopou Stream near Huelo, Maui (drainage area, 0.64 square mile) were lowest for August in record that began in December 1910. Similarly, the mean flow of 1.48 cfs for the month, and the daily mean of 0.90 cfs on August 27, on Waiakea Stream near Mountain View, Hawaii (drainage area, 17.4 square miles) were lowest for the month since records began in September 1930. Because of severe drought conditions in central and eastern parts of Maui, irrigation has been halted temporarily, causing considerable crop damage.

HYDROGRAPHS OF TWO LARGE RIVERS





Provisional data; subject to revision

USABLE CONTENTS OF SELECTED RESERVOIRS NEAR END OF AUGUST 1973

[Contents are expressed in percent of reservoir capacity. The usable storage capacity of each reservoir is shown in the column headed "Normal maximum."]

Reservoir Principal uses: F–Flood control I–Irrigation M–Municipal P–Power R–Recreation W–Industrial	End of July 1973	End of Aug. 1973	End of Aug. 1972	Average for end of Aug.	Normal maximum
	Percent of normal maximum				
NORTHEAST REGION					
NOVA SCOTIA					
Rossignol, Mulgrave, Falls Lake, St. Margaret's Bay, Black, and Ponhook Reservoirs (P)	82	76	55	47	223,400 (a)
QUEBEC					
Gouin (P)	85	94	54	71	6,487,000 ac-ft
Allard (P)	84	75	91	65	280,600 ac-ft
MAINE					
Seven reservoir systems (MP)	88	85	83	65	179,300 mcf
NEW HAMPSHIRE					
Lake Winnipesaukee (PR)	99	88	94	73	7,200 mcf
Lake Francis (FPR)	94	88	87	82	4,326 mcf
First Connecticut Lake (P)	91	86	83	83	3,330 mcf
VERMONT					
Somerset (P)	82	69	70	76	2,500 mcf
Harriman (P)	70	71	69	70	5,060 mcf
MASSACHUSETTS					
Cobble Mountain and Borden Brook (MP)	87	78	72	78	3,394 mcf
NEW YORK					
Great Sacandaga Lake (FPR)	82	68	79	71	34,270 mcf
Indian Lake (FMP)	96	82	96	70	4,500 mcf
New York City reservoir system (MW)	99	91	90	.....	547,500 mg
NEW JERSEY					
Wanaque (M)	95	84	84	76	27,730 mg
PENNSYLVANIA					
Wallenpaupack (P)	75	63	64	64	6,875 mcf
Pymatuning (FMR)	95	92	98	86	8,191 mcf
MARYLAND					
Baltimore municipal system (M)	99	98	100	87	85,340 mg
SOUTHEAST REGION					
NORTH CAROLINA					
Bridgewater (Lake James) (P)	92	90	90	87	12,580 mcf
High Rock Lake (P)	96	77	77	73	10,230 mcf
Narrows (Badin Lake) (P)	98	90	90	99	5,616 mcf
SOUTH CAROLINA					
Lake Murray (P)	89	83	87	70	70,300 mcf
Lakes Marion and Moultrie (P)	89	85	88	65	81,100 mcf
SOUTH CAROLINA--GEORGIA					
Clark Hill (FP)	78	75	76	64	75,360 mcf
GEORGIA					
Burton (PR)	85	85	86	86	104,000 ac-ft
Lake Sidney Lanier (FMPR)	65	63	57	58	1,686,000 ac-ft
Sinclair (MPR)	86	88	84	86	214,000 ac-ft
ALABAMA					
Lake Martin (P)	96	95	85	84	1,373,000 ac-ft
TENNESSEE VALLEY					
Clinch Projects: Norris and Melton Hill Lakes (FPR)	60	57	54	46	1,156,000 cfsd
Holston Projects: South Holston, Watauga, Boone, Fort Patrick Henry, and Cherokee Lakes (FPR)	81	69	75	52	1,452,000 cfsd
Douglas Lake (FPR)	80	56	56	47	703,100 cfsd
Hiwassee Projects: Chatuge, Nottely, Hiwassee, Apalachia, Blue Ridge, Ocoee 3, and Parksville Lakes (FPR)	89	81	75	67	512,200 cfsd
Little Tennessee Projects: Nantahala, Thorpe, Fontana, and Chilhowee Lakes (FPR)	81	78	81	69	745,200 cfsd
WESTERN GREAT LAKES REGION					
WISCONSIN					
Chippewa and Flambeau (PR)	87	79	98	75	15,900 mcf
Wisconsin River (21 reservoirs) (PR)	71	64	77	67	17,400 mcf
MINNESOTA					
Mississippi River headwater system (FMR)	32	32	42	35	1,640,000 ac-ft
MIDCONTINENT REGION					
NORTH DAKOTA					
Lake Sakakawea (Garrison) (FIPR)	98	95	98	.....	22,640,000 ac-ft
NEBRASKA					
Lake McConaughy (IP)	91	88	77	67	1,948,000 ac-ft
OKLAHOMA					
Keystone (FPR)	94	85	74	91	661,000 ac-ft
Lake O' The Cherokees (FPR)	95	84	86	82	1,492,000 ac-ft
Tenkiller Ferry (FPR)	102	100	87	89	628,200 ac-ft
Lake Altus (FIMR)	65	50	12	47	134,500 ac-ft
Eufaula (FPR)	91	83	70	76	2,378,000 ac-ft
OKLAHOMA--TEXAS					
Lake Texoma (FMPRW)	99	96	79	92	2,722,000 ac-ft
TEXAS					
Possum Kingdom (IMPRW)	81	84	98	79	724,500 ac-ft
Buchanan (IMPW)	68	65	85	76	955,200 ac-ft
Bridgeport (IMW)	60	66	60	61	270,900 ac-ft
Eagle Mountain (IMW)	95	97	91	87	190,400 ac-ft
Medina Lake (I)	100	100	100	48	254,000 ac-ft
Lake Travis (FIMPRW)	100	97	87	71	1,144,000 ac-ft
Lake Kemp (IMW)	45	42	41	51	461,800 ac-ft
THE WEST					
ALBERTA					
Spray (P)	69	79	86	83	210,000 ac-ft
Lake Minnewanka (P)	94	82	96	85	199,700 ac-ft
St. Mary (I)	84	69	60	74	320,800 ac-ft
WASHINGTON					
Franklin D. Roosevelt Lake (IP)	76	78	100	99	5,232,000 ac-ft
Lake Chelan (PR)	99	95	99	94	676,100 ac-ft
IDAHO--WYOMING					
Upper Snake River (7 reservoirs) (IMP)	64	46	77	57	4,282,000 ac-ft
WYOMING					
Pathfinder, Seminoe, Alcova, Kortes, and Glendo Reservoirs (I)	88	75	65	35	3,016,000 ac-ft
Buffalo Bill (IP)	86	68	94	90	421,300 ac-ft
Boysen (FIP)	100	95	93	86	802,000 ac-ft
Keyhole (F)	84	80	90	38	199,900 ac-ft
COLORADO					
John Martin (FIR)	0	0	0	19	364,400 ac-ft
Colorado–Big Thompson project (I)	96	88	77	62	722,600 ac-ft
Taylor Park (IR)	101	98	79	77	106,000 ac-ft
COLORADO RIVER STORAGE PROJECT					
Lake Powell; Flaming Gorge, Navajo, and Blue Mesa Reservoirs (IFPR)	73	73	58	.....	31,276,500 ac-ft
UTAH--IDAHO					
Bear Lake (IPR)	85	82	91	60	1,421,000 ac-ft
CALIFORNIA					
Hetch Hetchy (MP)	97	86	68	68	360,400 ac-ft
Lake Almanor (P)	93	89	75	52	1,036,000 ac-ft
Shasta Lake (FIPR)	89	81	76	72	4,377,000 ac-ft
Millerton Lake (FI)	78	44	31	41	503,200 ac-ft
Pine Flat (FI)	74	49	20	39	1,014,000 ac-ft
Isabella (FIR)	62	47	10	28	551,800 ac-ft
Folsom (FIP)	82	72	75	67	1,000,000 ac-ft
Lake Berryessa (FIMW)	92	89	74	80	1,600,000 ac-ft
Clair Engle Lake (Lewiston) (P)	91	84	85	82	2,438,000 ac-ft
CALIFORNIA--NEVADA					
Lake Tahoe (IPR)	86	77	72	63	744,600 ac-ft
NEVADA					
Rye Patch (I)	101	81	88	.....	157,200 ac-ft
ARIZONA--NEVADA					
Lake Mead and Lake Mohave (FIMP)	80	79	67	70	27,970,000 ac-ft
ARIZONA					
San Carlos (IP)	64	64	1	11	1,093,000 ac-ft
Salt and Verde River system (IMPR)	89	83	33	36	2,073,000 ac-ft
NEW MEXICO					
Conchas (FIR)	85	79	47	81	352,600 ac-ft
Elephant Butte and Caballo (FIPR)	33	30	4	24	2,539,000 ac-ft

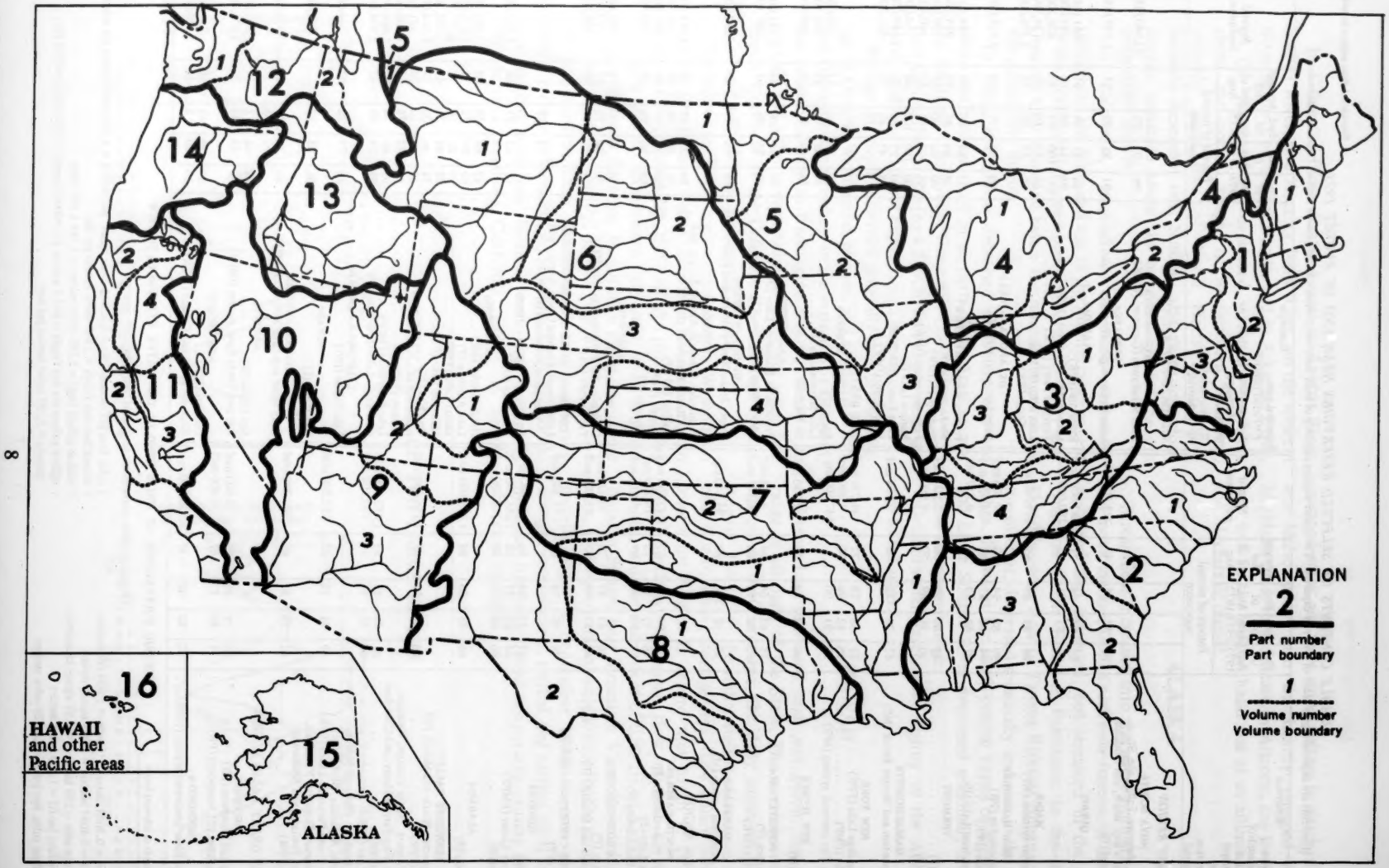
[a] Thousands of kilowatt-hours.

METRIC EQUIVALENTS OF UNITS USED IN THE WATER RESOURCES REVIEW

(Round-number conversions, to nearest four significant figures)

1 foot = 0.3048 meter 1 mile = 1.609 kilometers
1 acre = 0.4047 hectare = 4,047 square meters
1 square mile = 259 hectares = 2.59 square kilometers
1 acre-foot (ac-ft) = 1,233 cubic meters
1 million cubic feet (mcf) = 28,320 cubic meters

1 cubic foot per second (cfs) = 0.02832 cubic meter per second = 1.699 cubic meters per minute
1 second-foot-day (cfsd) = 2,447 cubic meters per day
1 million gallons (mg) = 3,785 cubic meters = 3.785 x 10^6 liters
1 million gallons per day (mgd) = 694.4 gallons per minute (gpm) = 2.629 cubic meters per minute = 3,785 cubic meters per day



Map showing areas covered by periodic reports on surface water supply of the United States (parts and volumes) and by annual reports on quality of surface waters (parts).

BASIC DATA REPORTS ON STREAM DISCHARGES, QUALITY OF SURFACE WATER, AND GROUND-WATER LEVELS

The 18 water-supply papers listed below have been published within the past year by the U.S. Geological Survey. They contain annual or multi-year basic-data records primarily of stream discharges; quality of surface water; and ground-water levels. These data result from water investigations by the Survey, many of which are carried on in cooperation with State, Federal, and other cooperating agencies.

These reports are a chronological continuation of those listed in several issues of the Water Resources Review in 1972. The ending date of the records in each report on stream discharges and quality of water is September 30 of the water year indicated; and the ending date in each report on ground-water levels is December 31 of the calendar year indicated. Each report is available for purchase at the price shown from the Superintendent of Documents, Government Printing Office, Washington, D.C. 20402. (NOTE: The abbreviations used below, WSP for Water-Supply Paper and USGS for U.S. Geological Survey, should be replaced by the fully spelled-out words when ordering any of the publications listed.)

STREAM DISCHARGES AND ELEVATION AND CONTENTS OF LAKES AND RESERVOIRS

Surface water supply of the United States, 1966–70, Part 3, Ohio River basin, Volume 2, Ohio River basin from Kanawha River to Louisville, Kentucky: USGS WSP 2108, 700 pages. 1972. $3.00.

Surface water supply of the United States, 1966–70, Part 3, Ohio River basin, Volume 4, Ohio River basin below Wabash River: USGS WSP 2110, 806 pages. 1973. $3.70.

Surface water supply of the United States, 1966–70, Part 5, Hudson Bay and upper Mississippi basins, Volume 3, Upper Mississippi River basin below Keokuk, Iowa: USGS WSP 2115, 607 pages. 1973. $3.20.

Surface water supply of the United States, 1966–70, Part 6, Missouri River basin, Volume 2, Missouri River basin from Williston, North Dakota, to Sioux City, Iowa: USGS WSP 2117, 612 pages. 1973. $3.20.

Surface water supply of the United States, 1966–70, Part 6, Missouri River basin, Volume 3, Missouri River basin from Sioux City, Iowa, to Nebraska City, Nebraska: USGS WSP 2118, 710 pages. 1973. $3.45.

Surface water supply of the United States, 1966–70, Part 6, Missouri River basin, Volume 4, Missouri River basin below Nebraska City, Nebraska: USGS WSP 2119, 901 pages. 1972. $5.75.

Surface water supply of the United States, 1966–70, Part 9, Colorado River basin, Volume 1, Colorado River basin above Green River: USGS WSP 2124, 543 pages. 1973. $2.95.

Surface water supply of the United States, 1966–70, Part 9, Colorado River basin, Volume 2, Colorado River basin from Green River to Compact Point: USGS WSP 2125, 634 pages. 1973. $3.20.

Surface water supply of the United States, 1966–70, Part 14, Pacific slope basins in Oregon and lower Columbia River basin: USGS WSP 2135, 1,036 pages. 1972. $4.25.

QUALITY OF SURFACE WATERS (Chemical and biological quality; suspended sediment; water temperature)

Quality of surface waters of the United States, 1967, Parts 9–11, Colorado River basin to Pacific slope basins in California: USGS WSP 2015, 702 pages. 1973. $3.00

Quality of surface waters of the United States, 1967, Parts 12–16, North Pacific slope basins, Alaska, and Hawaii and other Pacific areas: USGS WSP 2016, 431 pages. 1972. $2.00.

Quality of surface waters of the United States, 1968, Part 1, North Atlantic slope basins: USGS WSP 2091, 373 pages. 1972. $1.75.

Quality of surface waters of the United States, 1968, Part 3, Ohio River basin: USGS WSP 2093, 309 pages. 1973. $2.10.

Quality of surface waters of the United States, 1968, Parts 4 and 5, St. Lawrence River basin, and Hudson Bay and upper Mississippi River basins: USGS WSP 2094, 293 pages. 1973. $2.10.

Quality of surface waters of the United States, 1968, Part 6, Missouri River basin: USGS WSP 2095, 394 pages. 1973. $2.35.

Quality of surface waters of the United States, 1968, Part 11, Pacific slope basins in California: USGS WSP 2099, 389 pages. 1972. $2.75.

GROUND-WATER LEVELS

Ground-water levels in the United States, 1966–70, Southwestern States: USGS WSP 2010, 106 pages. 1972. $0.50. (Arizona, California, Hawaii, Nevada, and New Mexico.)

Ground-water levels in the United States, 1967–71, North-central States: USGS WSP 2090, 114 pages. 1973. $0.80. (Illinois, Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, South Dakota, and Wisconsin.)

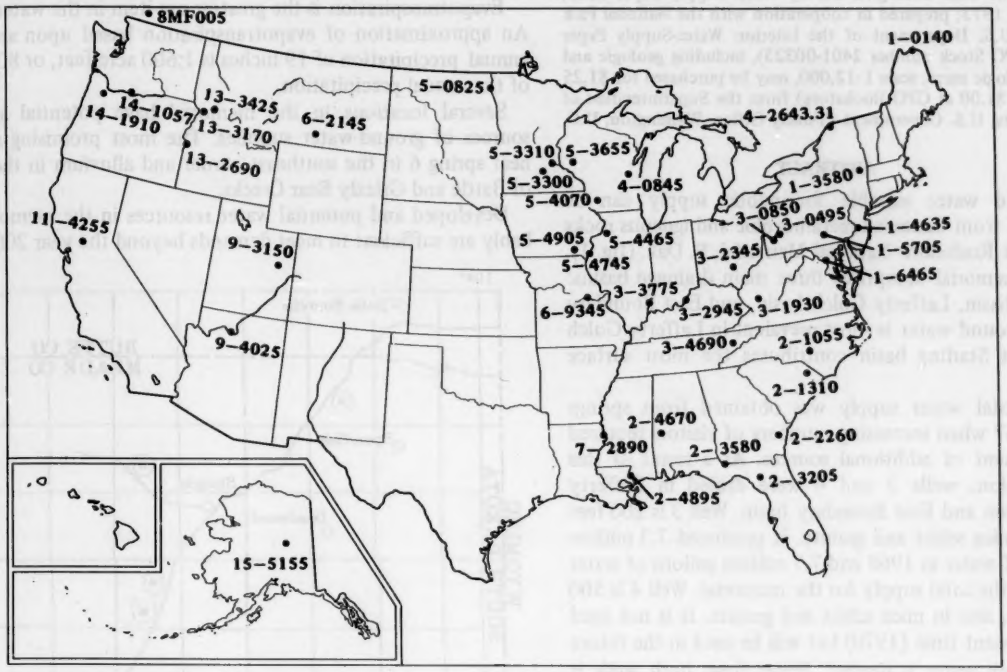
Provisional data; subject to revision

FLOW OF LARGE RIVERS DURING AUGUST 1973

Station number	Stream and place of determination	Drainage area (square miles)	Mean annual discharge through September 1970 (cfs)	August 1973					
				Monthly discharge (cfs)	Percent of median monthly discharge[1]	Change in discharge from previous month (percent)	Discharge near end of month		
							(cfs)	(mgd)	Date
1–0140	St. John River below Fish River at Fort Kent, Maine.	5,690	9,397	5,559	160	+16	2,300	1,500	31
1–3580	Hudson River at Green Island, N.Y.	8,090	12,520	5,467	109	-46	.....	.....	....
1–4635	Delaware River at Trenton, NJ	6,780	11,360	8,752	205	-52	4,270	2,800	28
1–5705	Susquehanna River at Harrisburg, Pa.	24,100	33,670	13,120	173	-31	8,020	5,200	31
1–6465	Potomac River near Washington, D.C.	11,560	[2]10,640	5,780	189	-2	4,200	2,700	31
2–1055	Cape Fear River at William O. Huske Lock near Tarheel, N.C.	4,810	4,847	2,794	94	-56	1,200	780	31
2–1310	Pee Dee River at Peedee, S.C	8,830	9,098	8,930	146	-17	4,610	3,000	28
2–2260	Altamaha River at Doctortown, Ga.	13,600	13,380	10,590	169	-1	7,650	4,900	26
2–3205	Suwannee River at Branford, Fla	7,740	6,775	8,920	166	-29	8,380	5,400	25
2–3580	Apalachicola River at Chattahoochee, Fla.	17,200	21,690	17,500	123	+1	14,200	9,200	29
2–4670	Tombigbee River at Demopolis lock and dam near Coatopa, Ala.	15,400	21,700	7,351	155	-59	2,730	1,800	27
2–4895	Pearl River near Bogalusa, La	6,630	8,533	3,800	138	+9	3,400	2,200	31
3–0495	Allegheny River at Natrona, Pa	11,410	[2]18,700	5,041	107	+2	4,600	3,000	29
3–0850	Monongahela River at Braddock, Pa.	7,337	[2]11,950	4,676	113	+61	4,200	2,700	29
3–1930	Kanawha River at Kanawha Falls, W.Va.	8,367	12,370	5,340	127	-18	5,340	3,400	26
3–2345	Scioto River at Higby, Ohio	5,131	4,337	4,026	445	-40	1,800	1,200	27
3–2945	Ohio River at Louisville, Ky[3]	91,170	110,600	42,500	142	-42	11,400	7,400	29
3–3775	Wabash River at Mount Carmel, Ill.	28,600	26,310	23,090	270	-29	12,100	7,800	31
3–4690	French Broad River below Douglas Dam, Tenn.	4,543	[2]6,528	5,417	175	-1	.....	.....	....
4–0845	Fox River at Rapide Croche Dam, near Wrightstown, Wis.[3]	6,150	4,142	2,300	105	-26	.....	.....	....
4–2643.31	St. Lawrence River at Cornwall, Ontario–near Massena, N.Y.[4]	299,000	239,100	323,000	128	-8	310,000	200,000	31
5–0825	Red River of the North at Grand Forks N. Dak.	30,100	2,439	743	62	-50	730	500	31
5–3300	Minnesota River near Jordan, Minn ..	16,200	3,306	794	432	-53	840	500	30
5–3310	Mississippi River at St. Paul, Minn ...	36,800	[2]10,230	7,770	108	+34	7,260	4,700	29
5–3655	Chippewa River at Chippewa Falls, Wis.	5,600	5,062	3,555	124	+29	.....	.....	....
5–4070	Wisconsin River at Muscoda, Wis	10,300	8,457	6,229	127	+4	6,500	4,200	31
5–4465	Rock River near Joslin, Ill	9,520	5,288	4,846	174	-39	4,120	2,700	31
5–4745	Mississippi River at Keokuk, Iowa ...	119,000	61,210	52,100	136	-19	51,000	33,000	31
5–4905	Des Moines River at Keosauqua, Iowa.	14,038	5,220	18,700	638	-11	15,800	10,200	31
6–2145	Yellowstone River at Billings, Mont.	11,795	6,754	4,246	80	-61	3,330	2,200	31
6–9345	Missouri River at Hermann, Mo	528,200	78,480	53,220	96	-40	59,900	38,800	27
7–2890	Mississippi River near Vicksburg, Miss.[5]	1,144,500	552,700	468,400	147	-24	400,000	258,000	30
9–3150	Green River at Green River, Utah ...	40,600	6,369	3,580	117	-60	5,500	3,600	31
9–4025	Colorado River near Grand Canyon, Ariz.	137,800	.....	9,640	.....	-7	.....	.....	....
11–4255	Sacramento River at Verona, Calif ...	21,257	18,370	14,480	168	+14	4,800	3,100	27
13–2690	Snake River at Weiser, Idaho	69,200	17,670	10,240	95	+5	11,200	7,200	30
13–3170	Salmon River at White Bird, Idaho ..	13,550	11,060	3,710	68	-46	3,420	2,220	30
13–3425	Clearwater River at Spalding, Idaho ..	9,570	15,320	3,907	109	-45	3,870	2,500	30
14–1057	Columbia River at The Dalles, Oreg.[6]	237,000	194,000	126,300	82	-4	.....	.....	....
14–1910	Willamette River at Salem, Oreg	7,280	23,370	6,523	116	+7	7,804	5,000	31
15–5155	Tanana River at Nenana, Alaska	27,500	24,040	48,970	88	-9	.....	.....	....
8MF005	Fraser River at Hope, British Columbia.	78,300	95,300	105,000	88	-41	69,900	45,200	30

[1] Reference period 1931–60 or 1941–70.
[2] Adjusted.
[3] Record furnished by Corps of Engineers.
[4] Record furnished by Buffalo district, Corps of Engineers, through International St. Lawrence River Board of Control. Discharges shown are considered to be the same as discharge at Ogdensburg, N.Y. when adjusted for storage in Lake St. Lawrence.
[5] Records of daily discharge computed jointly by Corps of Engineers and Geological Survey.
[6] Discharge determined from information furnished by Bureau of Reclamation, Corps of Engineers, and Geological Survey.

SELECTED STREAM-GAGING STATIONS ON LARGE RIVERS



Location of stream-gaging stations on large rivers listed in table on page 10.

WATER RESOURCES REVIEW — AUGUST 1973

Cover map shows generalized pattern of streamflow for August based on 22 index stream-gaging stations in Canada and 130 index stations in the United States. Alaska and Hawaii inset maps show streamflow only at the index gaging stations which are located near the points shown by the arrows.

Streamflow for August 1973 is compared with flow for August in the 30-year reference period 1931–60 or 1941–70. Streamflow is considered to be *below the normal range* if it is within the range of the low flows that have occurred 25 percent of the time (below the lower quartile) during the reference period. Flow for August is considered to be *above the normal range* if it is within the range of the high flows that have occurred 25 percent of the time (above the upper quartile).

Flow higher than the lower quartile but lower than the upper quartile is described as being within the *normal range*. In the Water Resources Review the median is obtained by ranking the 30 flows of the reference period in their order of magnitude; the highest flow is number 1, the lowest flow is number 30, and the average of the 15th and 16th highest flows is the median.

The normal is an average (but not an arithmetic average) or middle value; half of the time you would expect the August flows to be below the median and half of the time to be above the median. Shorter reference periods are used for the Alaska index stations because of the limited records available.

Statements about *ground-water levels* refer to conditions near the end of August. Water level in each key observation well is compared with average level for the end of August determined from the entire past record for that well or from a 20-year reference period, 1951–70. *Changes in ground-water levels*, unless described otherwise, are from the end of July to the end of August.

The Water Resources Review is published monthly. Special-purpose and summary issues are also published. Issues of the Review are free on application to the Water Resources Review, U.S. Geological Survey, Washington, D.C. 20244.

This issue was prepared by J.C. Kammerer, H.D. Brice, E.W. Coffay, I.G. Grossman, and L.C. Fleshmon from reports of the field offices, September 12, 1973.

WATER RESOURCES AND GEOLOGY OF MOUNT RUSHMORE NATIONAL MEMORIAL, SOUTH DAKOTA

The accompanying abstract and map are from the report, *Water resources and geology of Mount Rushmore National Memorial, South Dakota,* by J.E. Powell, J.J. Norton, and D.G. Adolphson: U.S. Geological Survey Water-Supply Paper 1865, 50 pages, 1973; prepared in cooperation with the National Park Service, U.S. Department of the Interior. Water-Supply Paper 1865 (GPO Stock number 2401-00323), including geologic and geohydrologic maps, scale 1:12,000, may be purchased for $1.25 (by mail; $1.00 at GPO Bookstore) from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

ABSTRACT

Ground water suitable for public supply can be obtained from fractured metamorphic and igneous rocks at Mount Rushmore National Memorial, S. Dak. (fig. 1).

The memorial comprises three main drainage basins: Starling basin, Lafferty Gulch basin, and East Boundary basin. Ground water is most prevalent in Lafferty Gulch basin but Starling basin contributes the most surface water.

The total water supply was obtained from springs until 1967 when increasing numbers of visitors required development of additional sources. As a result of this investigation, wells 3 and 4 were drilled in Lafferty Gulch basin and East Boundary basin. Well 3 is 200 feet deep in mica schist and granite. It produced 7.3 million gallons of water in 1968 and 7.7 million gallons of water in 1969, the total supply for the memorial. Well 4 is 500 feet deep, also in mica schist and granite. It is not used at the present time (1970) but will be used in the future when more water is needed. Water from both wells is potable, but the quality of water from well 3 is superior to that from well 4.

Mica schist is the most abundant rock in the memorial. The more prominent hills and mountains, however, are in large, northerly striking granite sills, some of which are several hundred feet thick. Pegmatite sills and dikes are also numerous. The western boundary of the memorial is at the east edge of the Harney Peak Granite batholith. The dip of schistosity and bedding schist adjacent to the batholith is about 30° E. but increases across the memorial to about 65° E. in the northeast corner.

At some locations in the memorial, granite or pegmatite sills act as ground-water dams preventing the movement of ground water down gradient. A pegmatite or granite sill is probably the cause of the accumulation of water in the vicinity of well 3. The well flows when it is not being pumped.

The occurrence of ground water is dependent upon the presence of joints and fractures in the schist and granite bedrock. The rocks themselves are relatively impermeable and would yield little or no water in their unaltered state.

Mica schist that has been intruded by granite and (or) pegmatite is more fractured and yields more ground water in the memorial than mica schist alone. This condition may be due to jointing and to the greater fracturability of the intruded rocks in the vicinity of granitic intrusions.

Ground water is also available from alluvium in major valleys such as Starling basin and the valleys of Grizzly Bear Creek and Battle Creek.

Evapotranspiration is the greatest use-item in the water budget. An approximation of evapotranspiration based upon an average annual precipitation of 19 inches is 1,600 acre-feet, or 80 percent of the annual precipitation.

Several locations in the memorial have potential as future sources of ground-water supplies. The most promising areas are near spring 6 in the southeast corner and alluvium in the valleys of Battle and Grizzly Bear Creeks.

Developed and potential water resources in the memorial probably are sufficient to meet demands beyond the year 2000.

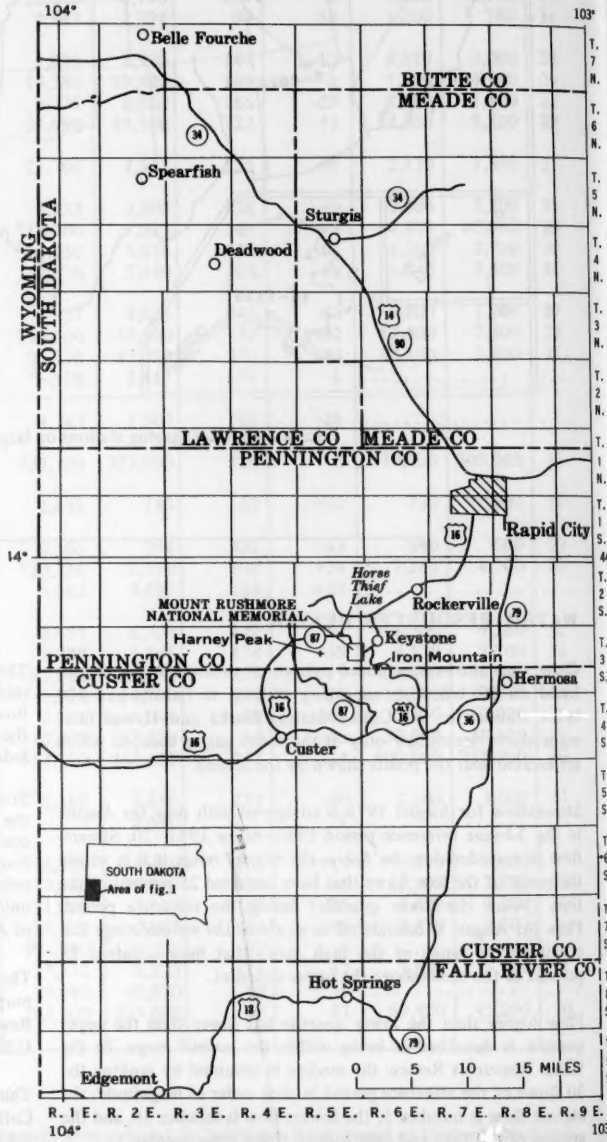


Figure 1.—Location of Mount Rushmore National Memorial and other localities mentioned in this report.

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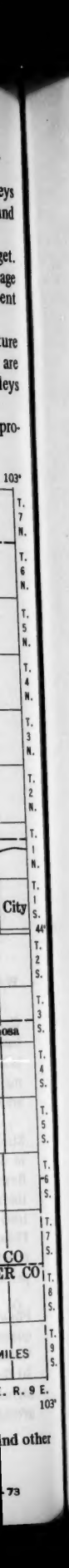

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